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(54) Reciprocating jib for handling articles

(57) A handling apparatus 1 for effecting load-transferring manoeuvres comprises a stand 3 which is connected to a base 2 and carries a pivotal drive 8 having a horizontal pivoting axis. A jib 11 is pivotable by means of the drive 8 about the pivoting axis and has a gripper arm 13 at its free end with a gripper 18. A support means 7 is arranged between the supporting base 2 and the gripper arm 13 and is drivable by a rectilinear drive 9 transversely of the pivoting direction of the jib 11. The support means 7 is arranged in front of the jib 11 as viewed in the gripping direction and is attached to a cantilever support 6 connected to the stand 3. The pivotal drive 8 is combined with the support means 7 and with a pivoting angle control device 10 to form one unit.

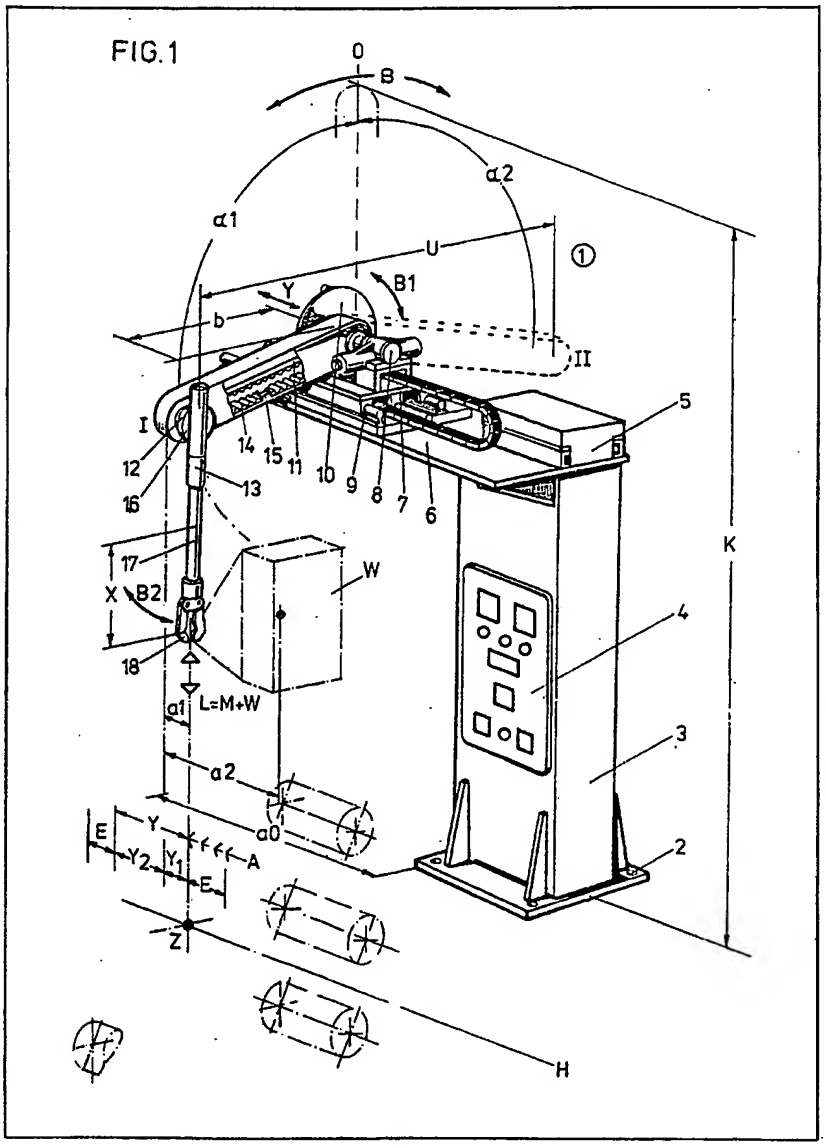

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FIG. 1

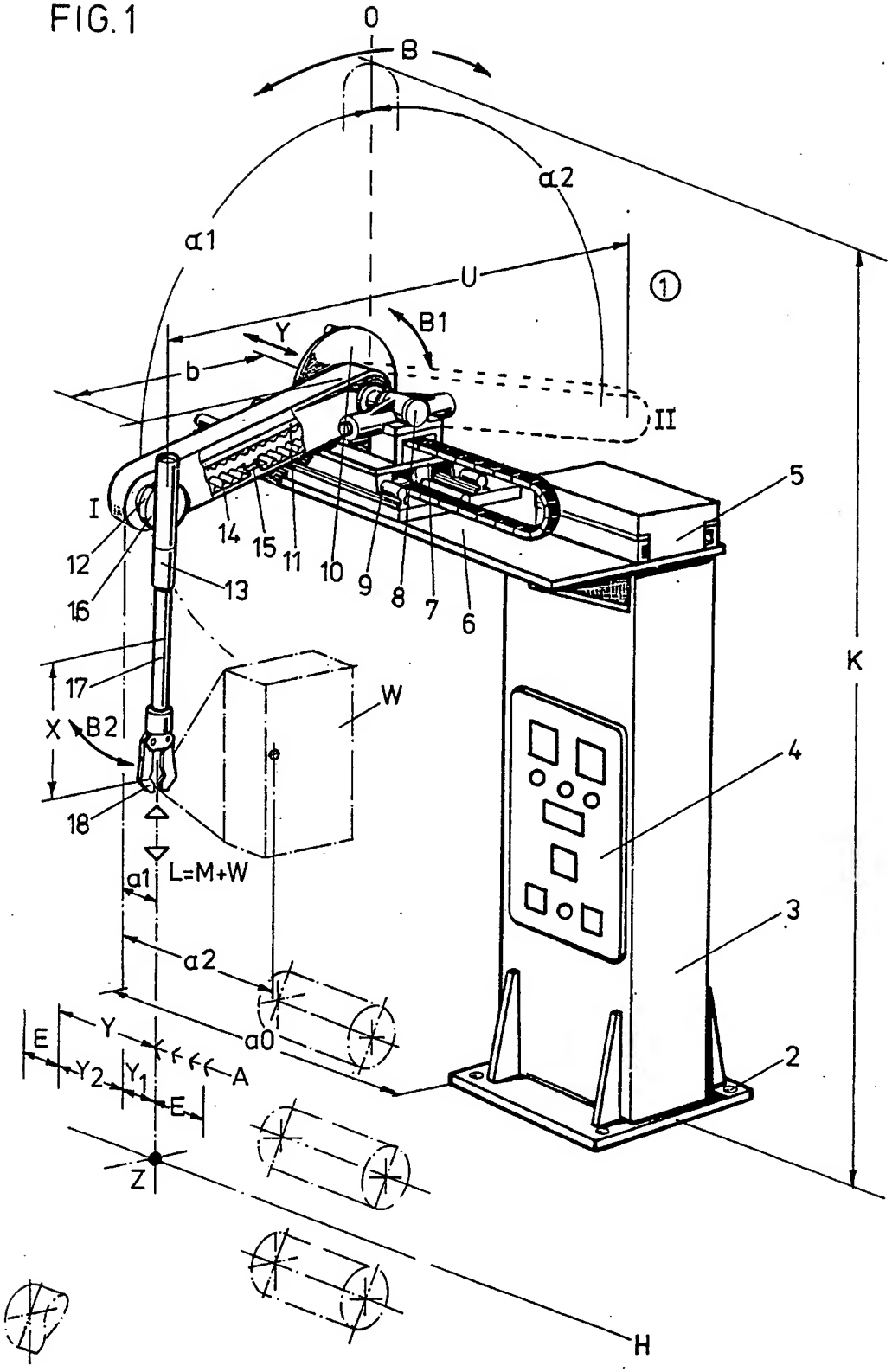

FIG. 2

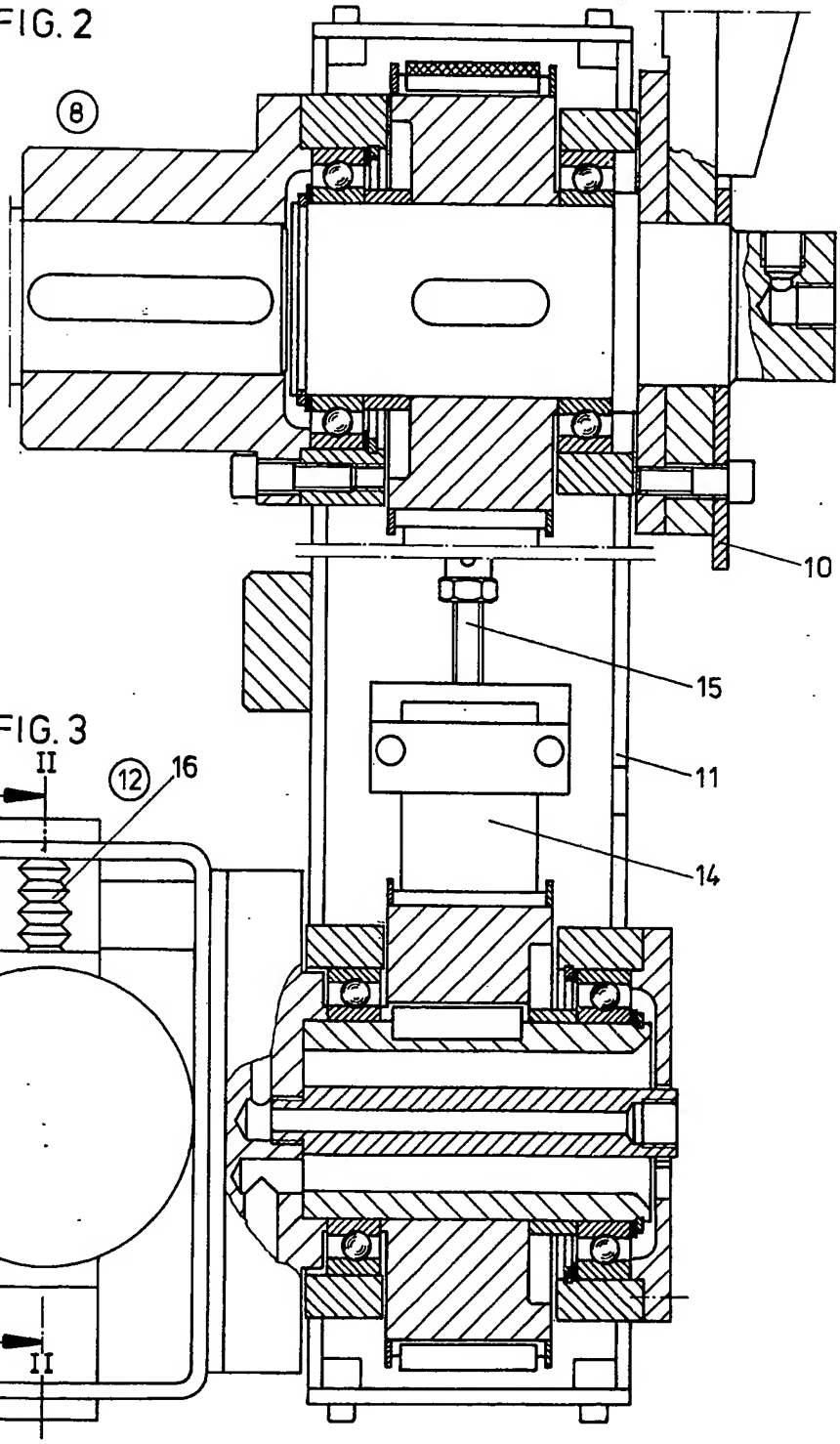

FIG. 3

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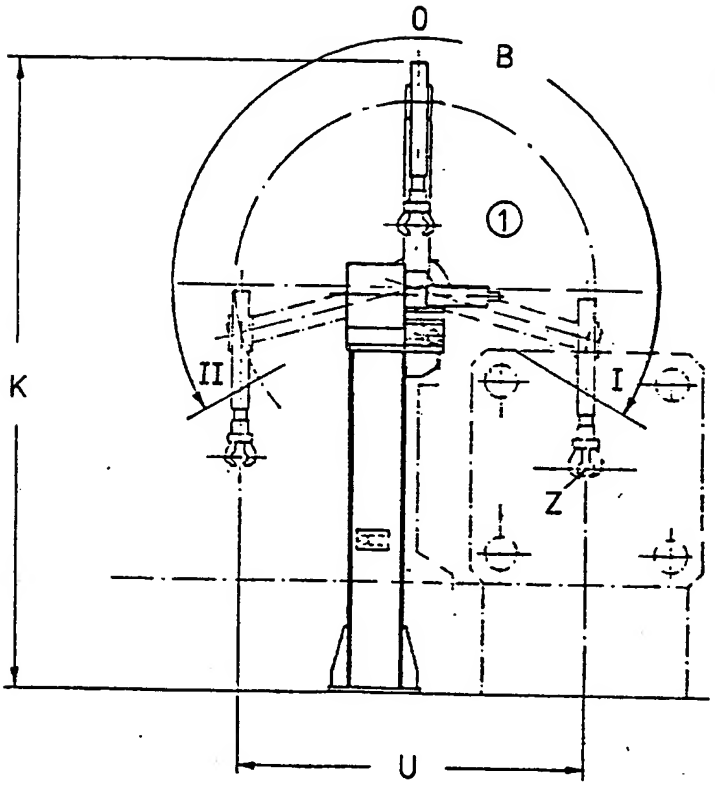

FIG.4

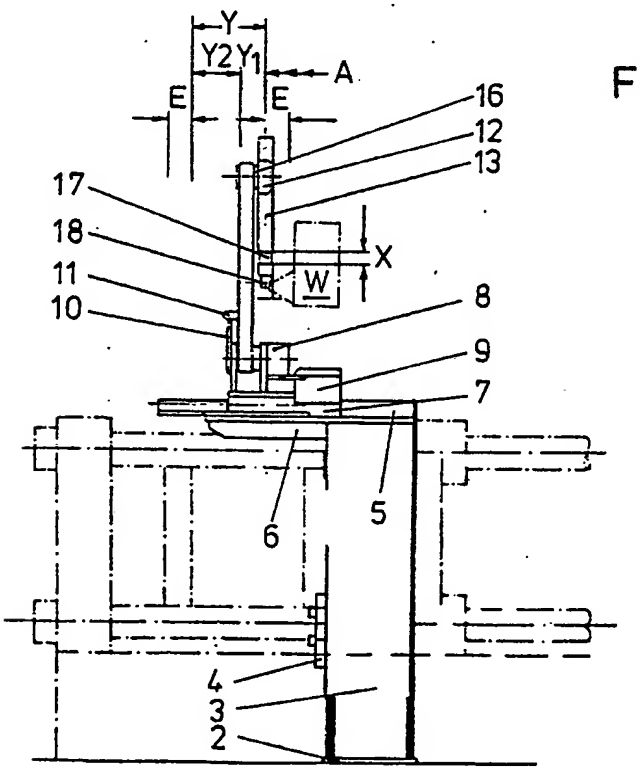

FIG.5

SPECIFICATION

A handling apparatus for effecting load-transforming manoeuvres.

This invention relates to a handling apparatus for effecting load-transferring manoeuvres, of the kind comprising a stand which is connected to a supporting base and carries a pivotal drive having a horizontal pivoting axis, a jib which is pivotable about said pivoting axis and has a gripper arm attached to its free end, a support means arranged between the supporting base and the gripper arm and drivable by a rectilinear drive transversely of the pivoting direction of the jib, and drive and control devices for movement and control, with and without load.

The field of application of such apparatus is mainly the unloading of pressure die casting machines and similar production machines which require not only a generous conveying distance, but also a variable adaptation to receiving position which can be displaced laterally substantially parallel with the supporting plane, for example, with varying depths of die or ejector strokes.

A handling apparatus is commercially available which can adapt itself by rapid pneumatic adjustment to the varying depths of die and ejector strokes by means of a support disposed on the pivoting end of the jib.

However, its construction is still unsatisfactory for the operator, more particularly when workpieces of relatively large dimensions and weights must be removed at a rapid cycle from press frames of particularly large overall width and height without the risk of damage to die or workpiece, and gently deposited at an adequate distance.

The disadvantages of this prior art construction are more particularly the following:

a) the support must share in the pivoting movements of the jib and thereby has an adverse effect on the useful load limit and economics;

b) as a result the jib is subjected to a considerable risk of oscillation and itself cannot be shifted laterally, so that it can also grip between large die halves;

c) the gripper cannot be adjusted by remote control to the precise gripping position without variation of pivoting radius and stand;

d) the actuation of the swivel drive and pneumatic support adjustment requires two different forms of energy, and this makes process control difficult and complicated;

e) the gripper arms has no security against lateral impacts and no self-locking of the normal position during impact damping;

f) adaptation to different gripping positions is difficult, due to the absence of slow speed and fine adjustment strokes;

g) the transferring distance is limited, due to the risk of collision with parts of the production machine;

h) there no safety impact dampers for the bearings or drives.

The aim of the invention is therefore primarily to provide a handling apparatus which (while meeting the basic functional demands):

— enables the masses to be moved on the free jib end during pivoting to be minimised;

— has high remote control positioning accuracy and speed with maximum degrees of freedom;

— is subjected in its own construction to only slight strength stressings, even with high useful loads and large distances;

— and has safety devices which prevent damage which might occur to rigid joints or inadequately sprung guides as a result of unforeseen peak stressings due to influences exerted by the production machine or tools.

Accordingly, the present invention consists in a handling apparatus for effecting load-transferring manoeuvres, comprising a stand which is connected to a supporting base and carries a pivotal drive having a horizontal pivoting axis, a jib which is pivotable about said pivoting axis and has a gripper arm attached to its free end, a support means arranged between the supporting base and the gripper arm and drivable by a rectilinear drive transversely of the pivoting direction of the jib, and drive and control devices for movement and control, with and without load, characterised in that the support means is attached directly to the stand or to a cantilever support connected thereto and is disposed in front of the jib, viewed in the gripping direction, the pivotal drive being combined with the support means and a pivoting angle control device to form one unit.

Advantages which can be achieved by means of the handling apparatus of the invention are more particularly:

a) The jib is free from the additional loading caused by a support means disposed at its free end and the further stressings caused by its operation.

b) The stand and the cantilever support and pivotal drive are stressed by lower bending and torsional forces than with a support on the jib.

c) Apart from its cable connections in the gripper arm, the zone of the gripper is unobstructed by hoses, cables and the like, which take up space and are particularly liable to damage in the production zone.

d) The complete drive block, comprising support means, rectilinear drive, pivotal drive, pivoting angle control device and support bearing of the jib can always be manufactured on the identical basic principle in the form of a versatile constructional group for different loads, jibs and grippers.

e) The course of movement is substantially free from oscillations and extremely precise, can be completely controlled in operating cadence, and can be quickly adapted geometrically, using re-adjustment facilities.

Advantageous further developments of the invention are contained in the subclaims.

The optional feature of the handling apparatus as set forth in claim 2 ensures that the forces to be diverted from the jib into the stand pass the

support means at a place which can be supported over a wide area, and that any remaining oscillating movements have little effect on positioning.

The arrangement of the jib as set forth in claim 3 ensures that the centroidal axis of all the pivoting construction elements is situated as close as possible to the stand, and that the inevitable residual torsional forces on the pivotal drive and stand, due to eccentric gripping of the gripper, are at least partially compensated by counter forces from the laterally offset arrangement of the elements.

The optional feature set forth in claim 4 ensures that the couplings of the various drives can be effected in a very simple and surveyable manner without transferring devices or separate connections.

The further optional feature set forth in claim 5 results in ready adaptability, accompanied by high positioning accuracy and a favourable flow of force in every pivoting position.

The construction set forth in claim 6 affords particular protection against damage due to oscillations and impacts.

The optional feature disclosed in claim 7 ensures that no lateral force on the gripper arm results in its permanent oblique position, thereby ensuring collision-free pivoting movement when required.

The optional feature disclosed in claim 8 ensures that both in the starting and pivoting position the gripper arm always extends in the direction of the force of gravity, so that the forces passing through the pivotal drive remain smaller than, for example, is the case with rigidly guided grippers. Moreover, the various re-adjusting and adjusting facilities, which act upon the interlinking device, also produce a wear-reducing and impact-damping effect.

The optional feature set forth in claim 9 ensures that both in the setting up of the course of the programme and also in rapid normal operation, no dangerous gripping errors caused by deviation in tolerance or the like or risks of oscillating have to be allowed for, and that changes in adjustment can be carried out during trials or the like with minimum expenditure of time and without risk of damage.

The embodiment as set forth in claim 10 further simplifies the construction according to the invention in the direction of a reliable power system with the possibility of controlling the course of the programme in dependence on the fixed points of a central operating speed and safety.

The optional feature set forth in claim 11 ensures that actuation is so effected by the hydraulic system, which permits maximum concentrations of force in very small and very light-weight adjusting members, so as to maintain optimum health and safety aspects of operation even when the apparatus is used in hot surroundings.

In order that the invention may be more readily understood, reference is made to the accompanying drawings which illustrate diagrammatically and by way of example embodiments thereof, and in which:—

Fig. 1 is a perspective view of the handling apparatus as a whole, including the axes and paths of movement.

Fig. 2 illustrates the pivotal drive in principle,

Fig. 3 shows a variant embodiment of the safety oscillating bearing with the mechanical self-locking system and re-adjustment device in the jib and on the interlinking device between the pivot bearing and the oscillating bearing,

Fig. 4 is a front elevation of the handling apparatus together with the production machine, and

Fig. 5 is a side elevation of the handling apparatus, showing clearly how the bending forces in the pivotal drive and cantilever support can be reduced by the laterally offset arrangement of the load and jib.

In the embodiment illustrated in Fig. 1, a handling apparatus 1 is used as an unloading apparatus on a production machine (main axis H). The apparatus is anchored on a supporting base 2 in a fixed manner, since methods have been found which enable the handling apparatus 1 to deal with all geometrical requirements of the sizes and weights of workpieces manufacturable by this production machine, without altering the position of the handling apparatus.

A stand 3 of the apparatus 1 and the ejection centre (Z) of the production machine (outlined in chaindot lines) are in an unalterable geometrical relationship to one another. For this reason the handling apparatus must also be adjustable to all sizes and weights of the workpieces and their dimensional deviations, so that the use of the production machine is not limited. The pivoting direction is preferably transverse in relation to the main axis H of the production machine.

On special order the stand 3 can be vertically adjustable. However, as a rule this is not required, due to the permanently determinable association with the production machine and all its production variants.

An instrument panel 4 is disposed with good accessibility from the floor in the side of the stand 3. A central hydraulic unit 5 forms the top closure of the stand 3 which is hollow column-like in this embodiment.

The overall height of the hydraulic unit 5 can be kept very small at this place, due to the fact that the reservoir, pump and motor can be partially accommodated inside the hollow column of the stand 3. With this manner of incorporation the operating noises can be satisfactorily insulated, and the risk of damage and dirtying due to waste from the conveyed material be reduced to a minimum.

Parallel with the main axis H of the production machine, the stand 3 has a rigid cantilever support 6, by which the main movable drive elements, combined in a block, are supported and guided.

In the embodiment illustrated, this purpose is

served by a support means and a rectilinear drive 9, disposed in this embodiment below a pivotal drive 8 and a pivoting angle control device 10. In this embodiment the pivotal drive 8 consists of a pinion (not shown), which can be driven by a rack. The rack can be steplessly actuated in the two opposite directions substantially transversely in relation to the axis H to the extent corresponding to the adjustments of the pivoting angle control device 10. In this case the start of movement would at the initial position 0 vertical and axially parallel with the main axis of the stand 3 and on the one hand the end position I for reception and on the other hand the end position II for depositing. The pivoting movement is therefore effected about a pivoting axis lying substantially parallel with the cantilever support 6 by means of the movement of a jib 11 rotating away over the stand 3 with its superstructures.

Fig. 2 illustrates the construction of the attachment of the jib 11 to the pivotal drive 8. Disposed at the outermost end of the jib 11 (an embodiment is illustrated in Fig. 3) is a safety pivot bearing 12 for a gripper arm 13, which by means of the bearing 12 and an interlinking device 14 incorporated in the jib 11 is always directed constrainedly perpendicularly downwards and secured against oscillation.

Further security is afforded by a preferably resilient re-adjusting device 15 (embodiment illustrated in Fig. 3) and a self-locking device 16 connected to the pivot bearing 12.

Since the production machine and its ejectors can produce in the starting position of the handling apparatus 1, and also during depositing, transverse impacts which would quickly damage a rigid bearing, the pivot bearing 12 has a safety spring and self-locking system operative in the direction from which such impacts might come, and is also of a purely mechanical, light-weight construction, to keep down the dead weight on the jib 11 (cf. also Fig. 3). The risk of collision is thereby considerably reduced, thus contributing also towards the rapid, sensitive controllability of all the possible gripping points which might be required, such controllability being achieved by a joint hydraulic and power supply, with slow and fast speeds, and high concentrations of force. In this embodiment the pivot bearing 12 is preferably disposed on the jib 11 on the side adjacent the stand 3. As a result, there is considerable compensation of the force which stresses the cantilever support 6 and is caused by the loading originating from the gripper arm 13 with the workpiece further cantilevered in the direction of the stand 3. However, this lateral offsetting of the axis of gravity of the load L in relation to the clamping place of the jib 11, which is carried out nearer in the direction of the stand 3, produces a certain torsional force in the jib 11 and pivotal drive 8 but such torsional force can be absorbed by the pivotal drive 8 and also by the box section of the jib 11 without appreciable influence on the driving force on the pivotal drive 8 required for every movement. Since the box section has a somewhat resilient torsional effect, it is even possible also to derive herefrom a further oscillation-damping effect which counteracts the oscillating movements of the jib 11 when receiving loads.

Description of operation:

Figs. 4 and 5 illustrate diagrammatically the operation of the handling apparatus 1 according to the invention, taking as an example a pressure die casting unloading operation. The start is in the initial position 0, in which the jib 11 stands perpendicularly over the pivotal drive 8, and the gripper arm 13 hangs parallel therewith with the extension 17 downwards. In this embodiment, therefore, the length of the gripper arm is immaterial as regards the required head height K of the handling apparatus 1.

To receive a load, the jib 11 then pivots at rapid speed about a pivoting axis B into the fetching position I, the gripper arm 13 and the elements attached thereto being kept constantly perpendicular. When the fetching position I, which can be precisely adjusted by a mechanical fine adjusting system E is reached, the opening of the gripper 18 is already in the actual gripping position Z, for example, the sprue of the workpiece W, with the die opened, but the workpiece not yet ejected. After the gripper 18 has gripped and closed, there takes place jointly with the initiation of the ejection operation, and in the same direction A the lateral movement Y of the support means 7 by means of its rectilinear drive 9, regulated to about the same speed (slow speed Y1), entraining all the elements suspended from the pivotal drive 8. As soon as the workpiece W no longer needs to be pushed by the ejectors—i.e., it has become completely released from the die—the further linear path (Y2) is covered at rapid speed into the final swung-out position I. From that point the pivoting operation then starts beyond the initial position 0 to the depositing position II, which in the always identical transferring distance U can take the form of a slide, for example, or the like substantially at the height of the gripper 18. When the workpiece has been deposited, the jib resumes the initial position 0.

CLAIMS

1. A handling apparatus for effecting load-transferring manoeuvres, comprising a stand which is connected to a supporting base and carries a pivotal drive having a horizontal pivoting axis, a jib which is pivotable about said pivoting axis and has a gripper arm attached to its free end, a support means arranged between the supporting base and the gripper arm and drivable by a rectilinear drive transversely of the pivoting direction of the jib, and drive and control devices for movement and control, with and without load, characterised in that the support means is attached directly to the stand or to a cantilever support connected thereto and is disposed in front of the jib, viewed in the gripping direction, the pivotal drive being combined with the support

means and a pivoting angle control device to form one unit.

2. A handling apparatus according to claim 1, wherein the support means is disposed between the stand and the pivotal drive.

3. A handling apparatus according to claim 1 or 2, wherein the jib is mounted and driven on the side of the pivoting angle control device adjacent the stand.

4. A handling apparatus according to any of claims 1 to 3, wherein the rectilinear drive, pivotal drive, gripper arm extension and gripper arm are connected to a joint power system and actuated by the same kind of power.

5. A handling apparatus according to any of claims 1 to 4, wherein the jib has at its free end a pivot bearing whose axis is parallel with the pivoting axis of the pivotal drive in the rest position and wherein mounted with provision for rotational movement in the pivot bearing is the gripper arm which is guided constrainedly in parallel in the direction of the centroidal axis by an interlinking device connected to the pivotal drive, the gripper arm and pivot bearing being disposed on the side of the jib adjacent to the stand.

6. A handling apparatus according to claim 5, wherein the gripper arm is resiliently mounted in the pivot bearing with limited rotational mobility in one direction.

7. A handling apparatus according to claim 5 or 6, wherein the pivot bearing has a self-locking device which operates in the pivoting direction of the gripper arm and whose function is independent of the movement of the pivotal drive and the particular jib position.

8. A handling apparatus according to any of claims 5 to 7, wherein the interlinking device is a parallel guide constituted by a toothed belt and the interlinking device has between the pivotal drive and the pivot bearing a re-adjusting device which automatically effects re-setting after stressing by impact or overloading.

9. A handling apparatus according to any of claims 1 to 8, wherein the support has a rectilinear drive, operative at least transversely of the pivoting direction of the jib, for slow and rapid speed over the normal stroke (Y), and also a manual precision adjustability of the end positions (E).

10. A handling apparatus according to any of claims 1 to 9, wherein the gripper arm has an extension which can be actuated in any desired manner, the pivotal drive, rectilinear drive and gripper can be driven by the same form of energy and wherein the pivoting angle control device can be coupled to the pivotal drive and rectilinear drive as regards operating sequences and positional geometry.

11. A handling apparatus according to any of claims 1 to 10. wherein the energy system used is a hydraulic system, preferably starting from a hydraulic unit which is incorporated in the stand.

12. A handling apparatus for load-transferring manoeuvres, substantially as herein described with reference to and as shown in the accompanying drawings.

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